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ORACBA News

United States Department of Agriculture Office of Risk Assessment and Cost-Benefit Analysis

Top Ten Traits of Good Risk Assessment

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As a scientist in the U.S. Department of Agriculture's (USDA) Food Safety and Inspection Service (FSIS), I appreciate the opportunities that Dr. Nell Ahl and her staff at the Office of Risk Assessment and Cost-Benefit Analysis (ORACBA) have offered to me and other colleagues who work in the risk assessment arena. At Nell's request, I presented the following material in the USDA Graduate School course in risk assessment earlier this year. I am pleased to offer my thoughts and opinions on the "Top Ten Traits of Good Risk Assessment:" to this audience. (See table 1.)

10.	clear scope, purpose, scheduled milestones of project
9.	experienced multidisciplinary team with high tolerance for ambiguity and deliberation
8.	thorough, but open, literature review and analysis
7.	clear delineation between science and judgement/assumptions
6.	multiple levels of transparency
5.	full description of uncertainty (and variability)
4.	reality check for all portions of model
3.	tone stressing risk assessment modeling as iterative process
2.	sensitivity/uncertainty analysis
1.	direct link to strategic research agenda, risk management, risk communication activities of Agency

Table 1. Top Ten Traits of Good Risk Assessment

Though my framework for presentation is a countdown, the number I assigned to each of the 10 traits does not necessarily indicate its rank or importance. What is important, from my perspective, is that each trait is considered an integral part of a good risk assessment process. Of course, good risk assessment is not conducted in a vacuum, as the Food and Drug Administration (FDA) realized in forming three teams operating in parallel for its *Listeria monocytogenes* project, one for each

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element of risk analysis (assessment, management, and communication). The risk analysis paradigm can also be depicted with a fourth crucial component: research. Risk assessment is thought of as a science-process, but collection of reliable representative data could drive all three processes in risk analysis. (See figure 1.) The interactions within and between agencies represented in the Federal Risk Assessment Consortium (http://www.jifsan.umd.edu/risk_assessment.htm) including the FDA; FSIS; Agricultural Research Service; ORACBA; Cooperative State Research, Education, and Extension Service; and others in government, industry, academia, and the international community, have had a remarkable impact upon the evolution of risk analysis for microbial hazards in the past few years.

Figure 1. Risk Analysis Paradigm

Trait 10 is that a risk assessment project ideally begins with a clear scope, purpose, and scheduled milestones for the project. My sense is that risk assessment is a relay race, with complex needs to negotiate multidisciplinary deliberations among risk managers, risk assessors, and stakeholders. Risk assessment may seem like more of a marathon than a relay. FSIS, with able assistance from LEADS Corporation and a dedicated multidisciplinary team, developed a novel approach involving risk assessors, risk managers, and stakeholders in the Assess Risk Core Business Process. Stakeholder input was envisioned in public meetings led by the FSIS Administrator to develop a risk assessment agenda that might include short- and long-term priorities for food safety needs. Once the risk assessment agenda is developed and prioritized, additional opportunities for stakeholder input might include a series of public meetings to describe the available evidence for risk assessment early in the process, to solicit additional data, and to comment on the risk analysis process, including the risk assessment results and proposed risk management alternatives. Some aspects of the Assess Risk Core Business Process are in place, but the links between risk assessment, risk management, and risk communication could be clarified for a more effective risk analysis process. A next step for FSIS to consider is developing strategies for fuller implementation of the process. The contributions of Steve Anderson, a risk fellow with the American Association for the Advancement of Science with the Epidemiology and Risk Assessment Division, and Nga Tran, a professor at John's Hopkins University on an Intergovernmental Personnel Agreement with the same division, may catalyze these efforts to improve risk analysis in FSIS.

Trait 9 in the countdown is that risk assessment is not an individual competition, but a team sport in which deliberations of many players with different skill sets and knowledge of different disciplines of science and policy must be integrated, weighed, and analyzed. Mark Powell, a colleague now with ORACBA, is credited with introducing me to the concept that a risk assessment team must have a high tolerance for ambiguity. Ambiguity may arise from sparse data or data related, but extrapolated to, a variable of interest to risk assessors. Such data may support many alternative interpretations. Often, the most plausible interpretation may not be obvious, so ambiguity must be recognized and acknowledged by the risk assessors. Also important for good risk assessment is a high tolerance for deliberation of the fine details of the data and judgements and implications of modeling

approaches amongst the team and with risk managers and risk communicators. Conducting good risk assessment is both a scientific and a managerial challenge with complex tasks. Teams have developed from FSIS and FDA that cross Department and agency bounds, bringing additional benefits, but also challenges in coordinating projects and tasks.

Trait 8 addresses the competing needs for completeness and timeliness in a dynamic system. The risk assessment team might begin the process as FSIS and FDA have done, conducting traditional literature reviews. The need for a more open process is obvious when new studies are published every day. The practice that developed to enhance openness to new information has been through convening public meetings with stakeholders where additional data is requested, and using professional societies and advisory groups as sounding boards and sources of data and scientific and analytical expertise. As new data or new interpretations of the same data are considered, the analysis is likely to change. The iterative nature of modeling could be more fully communicated in risk assessment reports, as emphasized further in Trait 3. The Joint Institute for Food Safety and Applied Nutrition (JIFSAN) Risk Analysis Clearinghouse (http://www.foodriskclearinghouse.umd.edu/) might be a prime source of existing data and models for risk assessors. The Risk Assessment Consortium, chaired by Wes Long of JIFSAN, is also filling a role for U.S. regulators in proposing development of a more formal peer review process for federal risk assessment projects.

Trait 7, clear delineation between science and judgement, seems to me overlooked in many risk assessment efforts. Distinguishing between science and judgement is essential to effective communication amongst a risk assessment team and between the team and the risk managers and stakeholders. In a simplistic sense, science might be described as observation or measurement of a system, and judgement might be described as assumptions or extrapolations about an unknown or unobserved system. For such complex analyses, good risk assessments would ideally inform stakeholders about the influence of alternative judgements on the outcome so that a single point estimate is not the take-home message from a good risk assessment.

Trait 6, multiple levels of transparency, may be the single most important point of good risk assessment. It seems to me that transparency is in the eye of the beholder, who may require a crystal ball to understand how data and judgements impact a good risk assessment model. Reality is that a risk assessment transparent enough to enable an independent analyst to duplicate and critique the modeling work is very different from the level of detail necessary for targeting less technical audiences. I am reminded of the opening of F. Scott Peck's book, *The Road Less Traveled*. "Life is difficult." So also, "Transparency is difficult." Risk assessors are still learning how to address the needs of multiple disciplines and audiences of different knowledge and skill levels. Wendy Fineblum and her JIFSAN colleagues are working to enhance transparency of risk assessment reports by development of hypertext links on the Risk Analysis Clearinghouse website.

The parenthetical in **Trait 5**, full description of uncertainty (and variability), may raise some eyebrows for those readers who view separating variability and uncertainty as a primary goal of good risk assessment. Sometimes, though we know a system is variable, we have no idea how to quantitate variability or separate it from uncertainty. For dose-response assessment, particularly for development of surrogate models, describing uncertainty as fully as practical may be of great benefit for microbial risk assessment. Variability exists for each aspect of the epidemiologic disease triangle (host, pathogen, and environment, and interactions). Predicting illness is not a simple binomial process, but rather a complex series of conditional events that might result in successful

disruption of pathogenesis or various adverse effects of differential severity. Depicting uncertainty in these predictions is even more complex. Clark Carrington of FDA developed the following approach that describes three basic forms of uncertainty: 1) parameter uncertainty associated with the fit of empirical models that consider sampling and measurement error; 2) model form, that is, which of many possible functional forms is likely to be the "true" form; and 3) analogical uncertainty about which of many possible surrogate datasets might be a good analogy for human dose-response relationships for related pathogens.

In my presentation at the USDA Graduate School, I ran a demo relating to parameter, model, and analogical uncertainty using an exciting new tool for dose-response modelers interested in uncertainty, the C++ object developed by Clark, with assistance from a contractor. The C++ object can fit data from human clinical trials to six empirical forms of threshold and non-threshold models, run bootstraps, and plot possibilities for dose-response models, even based on rather sparse data. The human dataset for *S. dysenteriae* trials included a total of 40 individuals administered one of four doses that appear to suggest a simple linear relationship on log dose scale. However, the series of bootstrapped models created with the C++ object illustrates vividly what we don't know from this dataset. We don't know from these meager data if the "true" dose-response relationship for shigellosis is linear, non-linear, or subject to threshold effects for healthy human volunteers. We also don't know how good an analogy these shigellosis models might be for other related pathogens, such as *Salmonella* Enteritidis or *Escherichia coli* O157:H7. The attendant uncertainty in the dose-response assessment may span many orders of magnitude. FDA expects to offer the C++ object on its JIFSAN web site, but copies can be obtained directly from Clark Carrington (cdc@cfsan.fda.gov) for those who would like to test this new tool.

Trait 4 on my countdown is important, attempting a reality check on intermediate and final outputs of the risk assessment model with independent data wherever possible. For microbial risk assessment models the exposure assessment accounts for much of the programming work. Often, the scenarios for times and temperatures of storage, handling, and cooking of foods are a complex mix of judgement and data. Many professional societies, including Society for Risk Analysis (SRA) and International Association for Food Protection (formerly IAMFES), and advisory groups, such as the National Advisory Committee on Microbiological Criteria in Foods, can assist with reality checks for risk assessment models. The Dose-Response Specialty Group (DRSG) of SRA, which convenes monthly conference calls for members, provided a critique for a microbial risk assessment modeling project at its Open Forum on June 6, 2000. As current president of the DRSG, I am promoting opportunities for meaningful dialogue between those risk assessors who have dealt with chemical and physical hazards for decades and microbial risk assessors who are just beginning to explore the issues of predicting the likelihood and severity of illness given dose and other factors. If you would like to join the August 1 or September 5 conference calls at 3:30 - 4:30 p.m., please call (202) 260-7280, access code 0577#.

Trait 3 emphasizes the importance of tone in communicating about risk assessment. Risk managers and stakeholders should understand that results of a risk assessment will change with new data or new assumptions and judgments. At best, risk assessment is like a snapshot at a particular point in time based on the available body of evidence and theory and judgments. Though prediction of risk with attendant uncertainty for foodborne pathogens is evolving as a process based as much as possible on science, risk assessment is an iterative process that is sensitive to data inputs and interpretations, as well as assumptions and extrapolations where data are lacking.

Trait 2, conducting sensitivity/uncertainty analyses,

is crucial to inform risk managers and stakeholders about the most influential portions of the model, especially when model inputs are more judgment than science. Risk assessment models could be powerful tools to drive strategic research agendas to improve risk assessment methodology and reduce uncertainty. Under the Food Safety Initiative, the FDA has begun this process by funding studies to link human and animal clinical trials for dose-response modeling.

Trait 1 brings us full circle, back to the process of risk analysis that involves risk assessors, risk managers, and stakeholders. (See figure 1.) Good risk assessment alone is not enough without linkage in a well-designed and well-managed risk analysis process. Again stressing the iterative nature of risk assessment, development of a strategic research agenda communicates much about the process. Leveraging risk assessment data needs with ongoing studies and expanding the scope of epidemiologic investigations have major implications for risk analysis. By linking research needs to reducing uncertainties associated with microbial risk assessment, regulators developing good risk analysis processes educate stakeholders in a proactive manner, which may improve credibility of the work.

Regarding leveraging and risk analysis, an interactive food safety kiosk, a notable advance in risk communication and food safety, will be presented by Dr. Jeannette Endres of Southern Illinois University at this December's SRA meeting in Arlington, VA. Using a touch screen, participants can take the food safety quiz on the kiosk that draws upon a "detective theme" based on the FSIS FightBAC™ campaign. The development and testing of the kiosk was funded by the Food Safety Strategic Research Initiative of the Illinois Council on Food and Agricultural Research (http://www.ag.uiuc.edu/~c-far/). Jeanette is excited to begin networking at her first SRA meeting to continue to bring risk analysis principles into her collaborative projects.

In closing, to promote good risk assessment and risk analysis processes, the analytical-deliberative process described by the National Research Council (1996) must be exercised fully. The activities of FSIS, with colleague Allan Hogue currently stationed with the World Health Organization in Geneva, and others in the international community to convene expert consultations on microbial risk assessment, should continue to open this evolving field for further deliberation and development of fuller understandings of global food safety and risk assessment.

Director's Corner by Nell Ahl

The goal of ensuring that USDA rules concerning human health, safety, or the environment are based on sound science requires scientific expertise of a number of specialists. That means that the best scientific scrutiny must be brought to bear on the analyses associated with major rules. The way that is accomplished in the scientific community is through peer review. I first wrote about peer review in an early Director's Corner. That column began, "Peer review is the cornerstone of science...[and] is important in risk assessment just as it is in science...." The piece was written when ORACBA was young and in the earliest stages of developing processes to guide peer review inside and outside ORACBA. Peer review remains an important cornerstone in risk assessment, and certain processes and traditions have evolved. Because of the increasing and enduring importance of peer

review, ORACBA now has guidelines for seeking peer review for risk assessments. These guidelines discuss ORACBA's commitment to peer review and define the conditions under which ORACBA seeks outside peer review. These activities all have as their underlying goal to support agencies in ensuring that the science underlying a rule and that the regulatory actions based on that rule can be upheld outside USDA.

ORACBA always conducts an in-house review. At least two of our scientists review every risk assessment and associated major rule. The goal is to provide constructive, consistent, and appropriate reviews to the manager responsible for making a decision based on the risk assessment. We strive to complete the review and return our suggestions, in writing, to the agency within 2 weeks. If requested, we are committed to discussing the review with agency personnel in person.

USDA is a department with a wide array of authorities concerned with protecting human health, safety, and the environment; many of these activities are managed by issuing regulations to implement programs for which USDA has authority. Because of this diversity, there is a wide array of scientific disciplines which contribute to USDA programs. ORACBA is a small unit with only four scientists, and the expertise for appropriate review for all risk assessments which accompany USDA major rules is not to be found within the office. Thus, it is crucial to seek peer review outside ORACBA. When the appropriate review expertise lies inside USDA or another government agency, we rely on this resource. When such expertise is not available, we seek scientific insight from specialists in universities or in non-governmental organizations.

External peer review occurs under the following circumstances: (a) when in-house scientific expertise is limited; (b) when a risk assessment is novel or precedent-setting; (c) when a risk assessment is conducted with substantial guidance and input from ORACBA; and (d) when agency scientists dispute the findings of a review conducted by ORACBA. When reviews are in conflict, whether in-house or externally, the Director of ORACBA reads the risk assessment in question and all the reviews conducted and then makes a determination, in writing, to guide the subsequent regulatory process.

In the context of reviewing the scientific content of a risk assessment, it is important to remember that the risk assessment does not make decisions on what to do about the risk, nor does ORACBA play a role in risk management choices. Those decisions are the responsibility of the risk manager of the agency writing the rule since there are many other issues which should be considered, including legal, social, economic, cultural, political, and others. Thus, the science as presented in the risk assessment is only one input into the decisionmaking. It is the responsibility of ORACBA to be sure that the best science is brought forth and presented in the most accurate and responsible way in the risk assessment, and that the risk mitigation choices are consistent with those addressed in the rule and will reduce the risk in question.

In seeking external peer review, ORACBA follows a tradition established by the Food Safety and Inspection Service (FSIS) and the Food and Drug Administration (FDA), both of which have a history of public input in the development and review of their risk assessments. For example, in completing risk assessments for *Salmonella* Enteritidis and *E. coli* O157:H7, FSIS sought ongoing data input and review from the public during the development of the risk assessment. In the final analysis, however, it was the risk managers in FSIS who decided what mitigations to apply to reduce the risk.

ORACBA is committed to providing the best review and constructive advice for the science and risk assessments used in USDA. Our goal is for USDA to be viewed as a Department in which science is used with honesty and integrity. Our

objective is to provide the best possible constructive criticism and advice to our clients, those agencies in the Department whose major rules we are required to review. If you would like to read the entire text of the ORACBA Guidelines on Peer Review, please check our website at: www.usda.gov/oce/oracba/index.htm

Now with this Director's Corner, I will say goodbye. The Directorship of ORACBA has been a wonderful and thoroughly enjoyable challenge. However, it is time to pursue other less hectic and demanding activities as I approach retirement. To accomplish this, I have the special opportunity to serve as the USDA Fellow to Tuskegee University's Center for the Integrated Study of Food, Animal and Plant Systems (CISFAPS) for 2 years. My work there, as here, will be focused on risk analysis for agricultural problems.

It has been a privilege to serve USDA as the first Director of ORACBA and to work with wonderful staff and colleagues from throughout the Department and other government agencies, consultants, and non-governmental organizations. The process of organizing and establishing ORACBA has been the culmination of my most extravagant career dreams. I could not have been successful without the help of many individuals, both in and out of government. In addition, a special thanks is due my wonderful staff, past and present, the "Oracbans" who labor long and hard to advance science policy activities in USDA. By August I will be ensconced at Tuskegee University. Not wanting to lose contact with colleagues and friends, my address, email, and phone number will be available from ORACBA. I'll still be looking forward to your support in these new adventures. Please keep in touch.

I'd like to close my final column with words from Abraham Lincoln which express some of my thoughts on leaving: "The pioneers in any movement are not generally the best people to carry that movement to a successful issue. They often have to meet such hard opposition, and get so battered and bespattered, that afterward, when people find out they have to accept reform, they will accept it more easily from others." With affection, I wish my successor well.

Risk Assessor in Profile: Mark Walderhaug

Our featured risk assessor in this issue is Dr. Mark Walderhaug, a microbiologist in the U.S. Food and Drug Administration's Center for Food Safety and Applied Nutrition (FDA/CFSAN). Mark works in the Microbial Ecology Branch of the Division of Microbiological Studies and is a member of the Food Safety Initiative's Microbiological Risk Assessment Team. He is currently working both on USDA's risk assessment of *E. coli* O157:H7 in ground beef and FDA's risk assessment of *Vibrio parahaemolyticus* in raw molluscan shellfish. Mark participated in the dose-response work in both risk assessments and was heavily involved in the computer simulation modeling for the FDA *V. parahaemolyticus* task force. Both risk assessments were released in draft in May for internal peer review, so Mark has been a very busy risk assessor indeed. Mark also frequently participates as a microbiologist on FDA traceback investigations of interstate *Salmonella* outbreaks—his participation in the search for evidence of *Salmonella* Enteritidis in egg-layer facilities helps to keep him grounded in regulatory realities. In 1999, he presented the FDA "Guide to Minimize Microbial Food Safety Hazards for Fresh Fruits and Vegetables" at a United Nations Food and Agriculture Organization (FAO)

sponsored event in Costa Rica and at a similar regional conference in Chile.

Mark earned his Ph.D. in Physiology at Vanderbilt University and held a postdoctoral appointment at the University of Chicago in the Molecular Genetics and Cell Biology Department. Before joining FDA in 1991, he was a Visiting Assistant Professor at the University of Illinois at Chicago Department of Immunology and Microbiology. He enjoys the opportunity that risk assessment of microbial pathogens presents to integrate many of his research interests: microbiology, molecular biology, physiology, mathematical modeling, and computers. Mark feels humbled by the discipline of risk assessment, however. In particular, two challenges weigh heavily on him. The first is the daunting problem of modeling genomic events in microbes (e.g., the acquisition and loss of virulence factors or antibiotic resistance by pathogens). The second challenge is the need to strike the right balance between, on the one hand, breadth and accuracy that lead to complexity in risk assessment, and on the other, the need for transparent and comprehensible analysis in support of public decisionmaking. He hopes that the FDA – University of Maryland collaboration of the Joint Institute for Food Safety and Applied Nutrition (JIFSAN) will help in tackling these problems.

April Risk Forum: Dr. Mark Tumeo

The April 12 Risk Forum featured Dr. Mark Tumeo, Director of the Program for Excellence in Risk Analysis at Cleveland State University. The presentation was titled "Resources in Risk Assessment." While the presentation was slanted to a U.S. Department of Agriculture audience, the information would be useful to other agencies or to non-governmental organizations that need to do risk assessments. Dr. Tumeo first gave an outline of different types of resources that are needed for each leg of the risk analysis triad: risk assessment, risk management, and risk communication.

In the next part of his presentation, Dr. Tumeo suggested several resource options along with a discussion of the advantages and disadvantages of each. The resource options he discussed were: 1) inside agency or other USDA agency, 2) universities, 3) consultants, 4) outside sources, including online sources, and 5) university centers. This discussion provided a framework to guide the selection of the best resources to meet a particular need. Every risk assessment has unique factors which will guide the selection of the best resources for each situation.

The final section of his presentation discussed the various university centers using his own center, the Program of Excellence in Risk Analysis at Cleveland State University, as an example of the functions and services that these centers offer. For more information about the program at Cleveland State, visit their website at www.csuohio.edu/cestp.

May Risk Forum: Dr. Richard Lowrance

On May 10, Dr. Richard Lowrance, an ecologist with the Agricultural Research Service, Southeast Watershed Research Laboratory (SEWRL) in Tifton, Georgia, presented the May Risk forum, entitled "Evaluation of Riparian Buffers in the USDA - Conservation Buffer Initiative." Dr. Lowrance's seminar addressed the ecosystem functions of riparian buffers and riparian

ecosystems on farms and agricultural landscapes. He began his discussion by providing programmatic context, noting that the USDA Conservation Buffer Initiative to implement 2 million miles of buffers by the year 2002 is being implemented through a variety of programs including the Conservation Reserve Program, Conservation Reserve Enhancement Program, Environmental Quality Incentives Program, and the Wetlands Reserve Program. The purposes of riparian buffer ecosystems are to: mitigate the adverse off-site environmental effects of agricultural production systems and other human activities; reduce pollution in the broadest sense, including chemicals, sediment, hydrologic modification, and pathogens; protect critical areas from expected external effects of production systems (as a form of insurance); protect critical areas from extreme events (as a form of catastrophic insurance); aid in the restoration of streambanks; provide recreation, hunting, woodlots, aesthetic benefits in managed landscapes; provide habitat for plant and animal species unable to survive in other portions of a managed landscape; and sequester carbon. Dr. Lowrance observed that although useful databases are being collected by the USDA Natural Resources Conservation Service and Farm Service Agency on the type and real extent of different riparian buffer systems, little is known about the functions of these buffers for water quality improvement, aquatic ecosystem restoration, ecosystem enhancement, wildlife habitat, and landscape diversity. In order to adequately assess the benefits of the Conservation Buffer Initiative, Dr. Lowrance indicated that we need scientific methods to quantitatively estimate the functions of these buffers at field, farm, landscape, state, and finally national scales. He discussed a variety of techniques and tools that can be used to examine the effects of riparian buffers on water quality. For example, the Riparian Ecosystem Management Model developed by SEWRL simulates hydrology, nutrient dynamics, and plant growth for land areas between the edge of fields and a water body and allows designers to develop buffer systems to help control non-point source pollution. To learn more about research conducted by Dr. Lowrance and his colleagues, visit the SEWRL web page at: http://sacs.cpes.peachnet.edu/sewrl.

June Risk Forum: Dr. Tsegaye Habtemariam and David Oryang

The June14 Risk Forum featured Dr. Tsegaye Habtemariam and David Oryang from the Tuskegee University Biomedical Information Management Systems and Center for Computational Epidemiology. The presentation was called “Epidemiologic Modeling and Risk Analysis.” Dr. Habtemariam was trained as a veterinarian and epidemiologist and has worked extensively in the development of risk assessment applications for biological systems. He uses epidemiologic methods as the framework upon which risk analysis is based.

Dr. Habtemariam discussed the concept of computational science. He noted that this is the third branch of science along with empirical science and theoretical science. Computational science is the arena which has allowed the development of risk assessment. The development of computer modeling and Monte Carlo analysis has served as the medium for the growth of risk assessment.

Dr. Habtemariam gave a short overview of epidemiology, including systems modeling of disease in a population. He also introduced the two-by-two table, the classic epidemiology tool, along with a discussion of such factors as prevalence, sensitivity, and specificity. He then provided simple examples of scenario analysis with emphasis on the branches that carry the risk. The core concept of risk analysis is following the risk. Mr. Oryang presented a case study example of their methods using a risk assessment for importing beef from a country where foot and mouth disease could be present. This risk assessment will be published later this summer as

part of an upcoming Animal and Plant Health Inspection Service rule concerning importation of boneless beef from two states in Brazil.

In closing, Dr. Habtemariam reemphasized the link between epidemiologic modeling and risk analysis along with a systems approach to incorporate population dynamics. For further information on epidemiological modeling and risk analysis and the Tuskegee University Center for Computational Epidemiology, please see their website at ccebims.tusk.edu.

Risk Calendar

July 2000

July 10 - 14 – *Quantitative Risk Assessment* course sponsored by USDA and FDA through the Graduate School, USDA. For more information or to register, contact Ann-Lloyd Hufstader at (202) 314-3411.

July 12 – ORACBA Risk Forum, "Quantitative Analysis of Variability and Uncertainty," Dr. Christopher Frey, Department of Engineering, North Carolina State University. The Forum will be held from 10:00 a.m. to 11:30 a.m. in Room 107A, Whitten Building, 12th & Jefferson Drive, SW, Washington, DC, followed by a workshop from 1:00 p.m. - 4:00 p.m. in Room 0768, South Building, 1400 Independence Avenue, SW, Washington, DC. For more information, call (202) 720-8022.

July 27 - 31 – 6th Biennial Conference on Communication and Environment, Cincinnati, OH. Contact Steve Depoe, Conference Co-Planner, University of Cincinnati, Department of Communication, Center for Environmental Communication Studies, P.O. Box 210184, Cincinnati, OH 45221-0184 or call (513) 556-4459, fax (513) 556-0899, E-mail depoe@uc.edu. Also see http://www.esf.edu/coce/conf01.htm.

August 2000

August 6 - 9 – 87th Annual Meeting, International Association of Food Protection, Hilton Atlanta, Atlanta, GA. For more information, call (800) 369-6337 or (515) 276-3344, fax (515) 276-8655, or see www.foodprotection.org.

August 9 – No ORACBA Risk Forum

August 16 - 18 – Future Research for Improving Risk Assessment Methods: Of Mice, Men, and Models, Aspen. CO. NIOSH is sponsoring this meeting, which will be limited to approximately 150 participants; however, a limited number of openings are available on a first-come, first-served basis. Complete workshop information, including registration form, is available at http://www.cdc.gov/niosh/pdfs/riskreg.pdf.

August 23 - 26 – Risk Analysis in Animal Health and Food Safety, Copenhagen, Denmark. See http://www.raph.dk/common/cac/risk.htm.

September 2000

September 5 - 8 – Probabilistic Risk Analysis: Assessment, Management, and Communication, Harvard School of Public Health, Boston, MA. Contact Harvard School of Public Health, Center for Continuing Professional Education, 677 Huntington Ave., Boston, MA 02115-6096 or call (617) 432-1171, fax (617) 432-1969, E-mail contedu@hsph.harvard.edu. For more information, see http://www/hsph.harvard.edu/ccpe.

September 5 – Introduction to Risk Sciences and Public Policy, Johns Hopkins University, School of Hygiene and Public Health, East Baltimore Campus. Course meets Mondays and Wednesdays through

October 27,2000. For more information, call Johns Hopkins university, School of Hygiene and Public Health at (410) 614-6200.

September 10 - 12 – Beltsville Symposium XXIV, Healthy Animals 2000, Friends of Agricultural Research, Beltsville, MD. For more information, see http://www.barc.usda.gov/fmod/symposium.

September 18 - 20 – SRA Workshop on Bayesian Approaches to Human Health Risk Assessment: Combining Different Kinds of Information.

Registration form and informational brochure forthcoming, see http://www.sra.org.

October 2000

October 10 - 13 – Ecological Toxicology and Environmental Risk Assessment, New Brunswick, NJ. Contact Environmental and Occupational Health Sciences Institute, Centers for Education and Training at (732) 235-9450, fax (732) 235-9460, E-mail cet@eohsi.rutgers.edu. For more information, see http://www.eohsi.rutgers.edu/cet.

October 11-13 – Second NSF International Conference on Food Safety: Preventing Foodborne Illness Through Science and Education, Hyatt Regency Hotel, Savannah, Georgia. For more information, contact Wendy Raeder at NSF Food Safety Conference, 789 Dixboro Rd., Ann Arbor, MI 48105 or call (734) 827-6888, fax (734) 827-6831, or E-mail raeder@nsf.org

October 11-13 – International Conference on Computer Simulation in Risk Analysis and Hazard Mitigation, Bologna, Italy. For further information, contact Karen Neal, Marketing Coordinator, Wessex Institute of Technology, Ashurst Lodge, Ashurst, Southampton. For more information, see http://www/wessex/ac/uk/conferences/2000/risk2000.

October 24 - 27 – International Society of Exposure Analysis - ISEA2000, Asilomar Conference Center, Monterey, CA. For more information, see http://www.iseaweb.org/isea2000.html.

October 30 – Methods in Quantitative risk Assessment, Johns Hopkins University, School of Hygiene and Public Health, East Baltimore Campus. Course meets Mondays, Wednesdays and Thursdays through December 22, 2000. For more information, call Johns Hopkins University, School of Hygiene and Public Health at (410) 614-6200.

December 2000

December 3 - 6 – 2000 Annual Meeting, Society for Risk Analysis, Crystal Gateway Marriott Hotel, Arlington, VA. For further information, contact John Ahearne at (919) 547-5213, fax (919) 549-0090, E-mail ahearne@sigmaxi.org

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The ***ORACBA*** *Newsletter* reports risk analysis activities in the U.S. Department of Agriculture, upcoming meetings and events, and other activities supporting the development and use of risk assessment in USDA. This quarterly newsletter is available at no charge to risk assessment professionals in USDA. Send comments or address changes to: USDA, **ORACBA**, Room 5248-S, Mail Stop 3811, 1400 Independence Avenue, SW, Washington, D.C. 20250-3811. Call (202) 720-8022, or fax (202) 720-1815.

ORACBA News

United States Department of Agriculture Office of Risk Assessment and Cost-Benefit Analysis